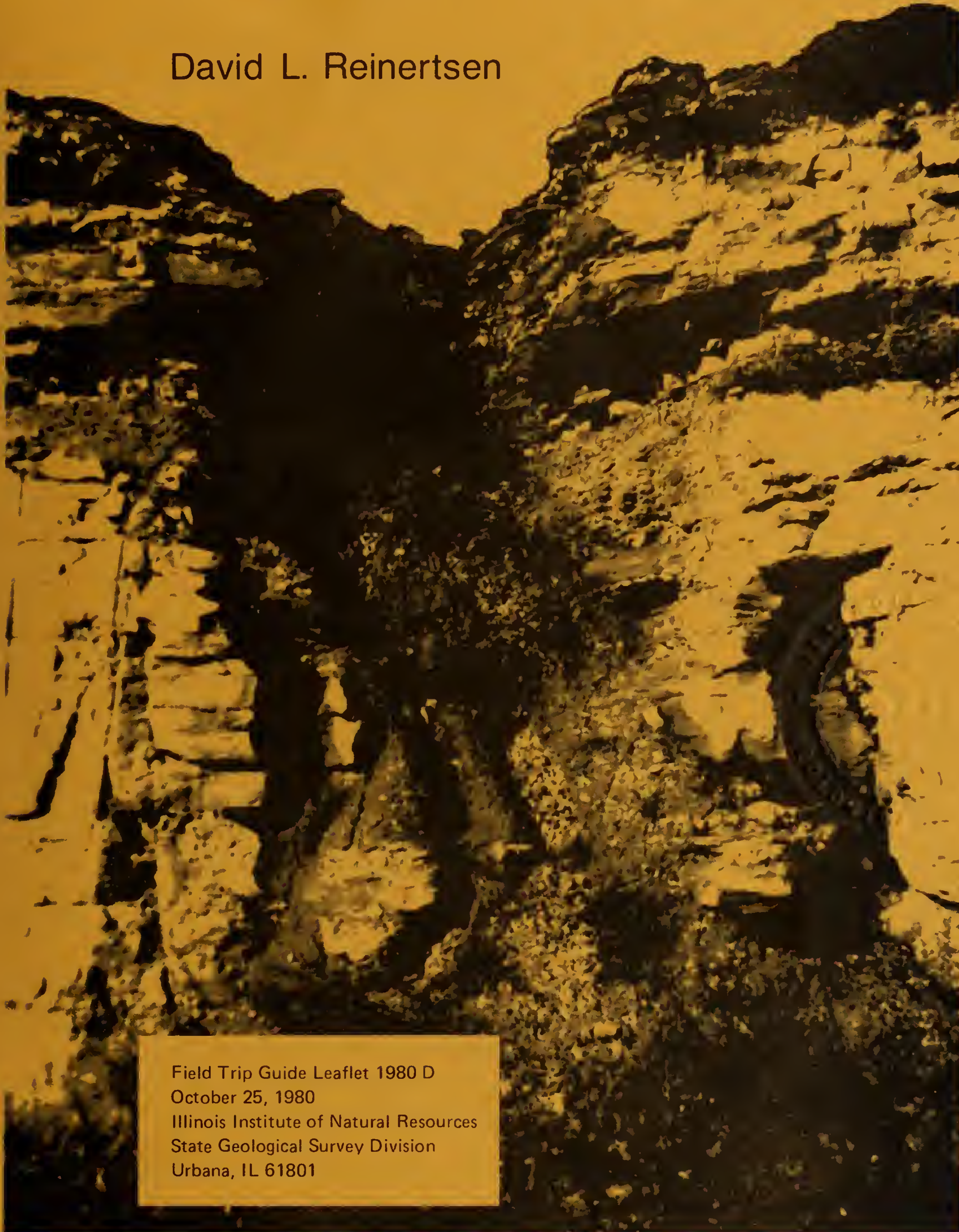
Geol Survey

Guide to the geology of the Quincy North area

David L. Reinertsen



Field Trip Guide Leaflet 1980 D
October 25, 1980
Illinois Institute of Natural Resources
State Geological Survey Division
Urbana, IL 61801

Commemorating the 50th Field Trip Season and the Survey's 75th year.

Cover: Cross section of one of the larger sinkholes exposed along the west side of State Route 336 at Stop 2.

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A guide to the geology of the Quincy North area

In 1930 the Geological Survey was 25 years old and the new Educational Extension Section was conducting its first field trips. Dr. M. M. Leighton, the Survey's third Chief, had created the section and its program "...to cooperate with the science teachers of the state and furnish them information regarding geology, such as will be helpful in their teaching of earth history and the development of life."

Part of the Section's work was to start a series of six annual "earth history field trips." More than 250 teachers and laymen attended the first year's trips near Dundee, La Salle-Starved Rock, Charleston-Mattoon-Effingham, Harrisburg-Shawneetown, Quincy, and Rock Island. In its 50 years (except for the war years 1942 to 1945), Ed. Extension has conducted more than 290 field trips. In 1979, 367 people from all walks of life attended the Survey's four field trips.

Teachers on the Quincy field trip, October 4, 1930, assemble in a quarry.

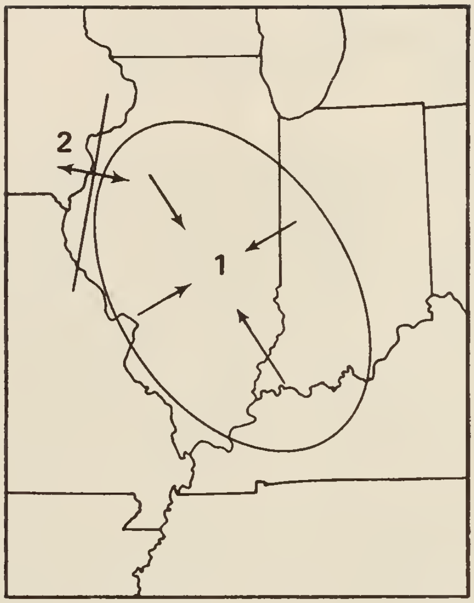


Figure 1. Index map with locations of (1) Illinois Basin, and (2) Mississippi River Arch.

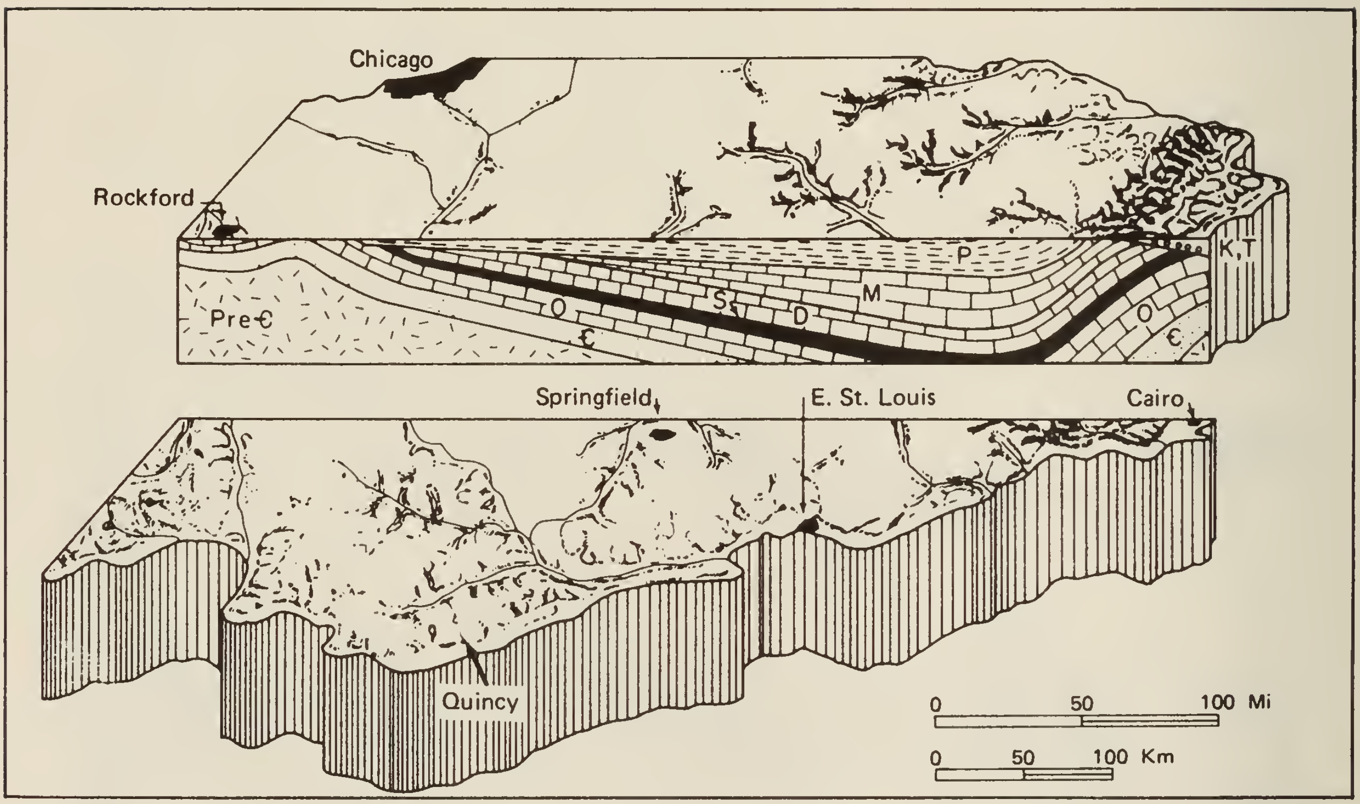


Figure 2. Stylized north-south cross section shows the structure of the Illinois Basin. In order to show detail, the thickness of the sedimentary rocks has been greatly exaggerated and the younger, unconsolidated surface deposits have been eliminated. The oldest rocks are Precambrian (Pre-C) granites. They form a depression that is filled with layers of sedimentary rocks of various ages: Cambrian (C), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K), and Tertiary (T). The scale is approximate.

the geologic framework

Physiography and geology of the area

The Quincy North field trip area in western central Illinois was glaciated more than once during the past million years or so. Some of the oldest known glacial deposits, of Nebraskan Age and Kansan Age, have been found in this part of our state (see *Pleistocene glaciations in Illinois* at the back of the guide leaflet).

The field trip area lies within the Dissected Till Plains Section of the Central Lowlands Province, an area covered by Nebraskan and Kansan glaciers (see map of the *Physiographic divisions of Illinois* and the *Glacial Map of Illinois* included at back of guide leaflet). The northeastern part of the field trip area crosses onto the Galesburg Plain of the Till Plains Section, an area covered by Illinoian glaciers. Glacial deposits are exposed best along stream valleys and in new roadcuts. These deposits include pre-Illinoian outwash gravels and tills, Illinoian outwash and loess, and Wisconsinan outwash and loess.

The Quincy area can be divided into three areas: (1) the Mississippi River valley, (2) the dissected uplands adjacent to the valley, and (3) the gently rolling to flat upland plains developed on glacial till. Drainage of the area is southwestward to the Mississippi River, which occupies a rock-walled gorge eroded into Mississippian limestones. Glacial drift in the area is thin and tributaries to the Mississippi River have deeply dissected the glacial deposits. The topography is rugged and reflects at least some of the irregularities of the bedrock surface, including sinkholes locally. The rugged topography of the Dissected Till Plains Section contrasts markedly with the younger, more even, and relatively less dissected Illinoian till plain (Galesburg Plain) some 20 miles to the east except in the northeastern part of the field trip area. Wind-blown loess (pronounced "luss") blankets the ground surface throughout the area.

Bedrock exposed in the field trip area consists of Mississippian limestone, shale, and siltstone of the Valmeyeran Series deposited nearly 335 million years ago. Limestone is the predominant rock in this area and is the basis of an active quarrying industry. These limestones are well exposed along the Mississippi River bluff in this area, which marks the northwestern margin of the Illinois Basin—a large, spoon-shaped, bedrock structure covering most of Illinois and adjacent parts of Indiana and Kentucky (fig. 1). Quincy is located along the crest of the broad Mississippi River Arch from which the bedrock dips gently southeastward into the deepest part of the Illinois Basin (figs. 1 and 2). While this basin was slowly subsiding during the

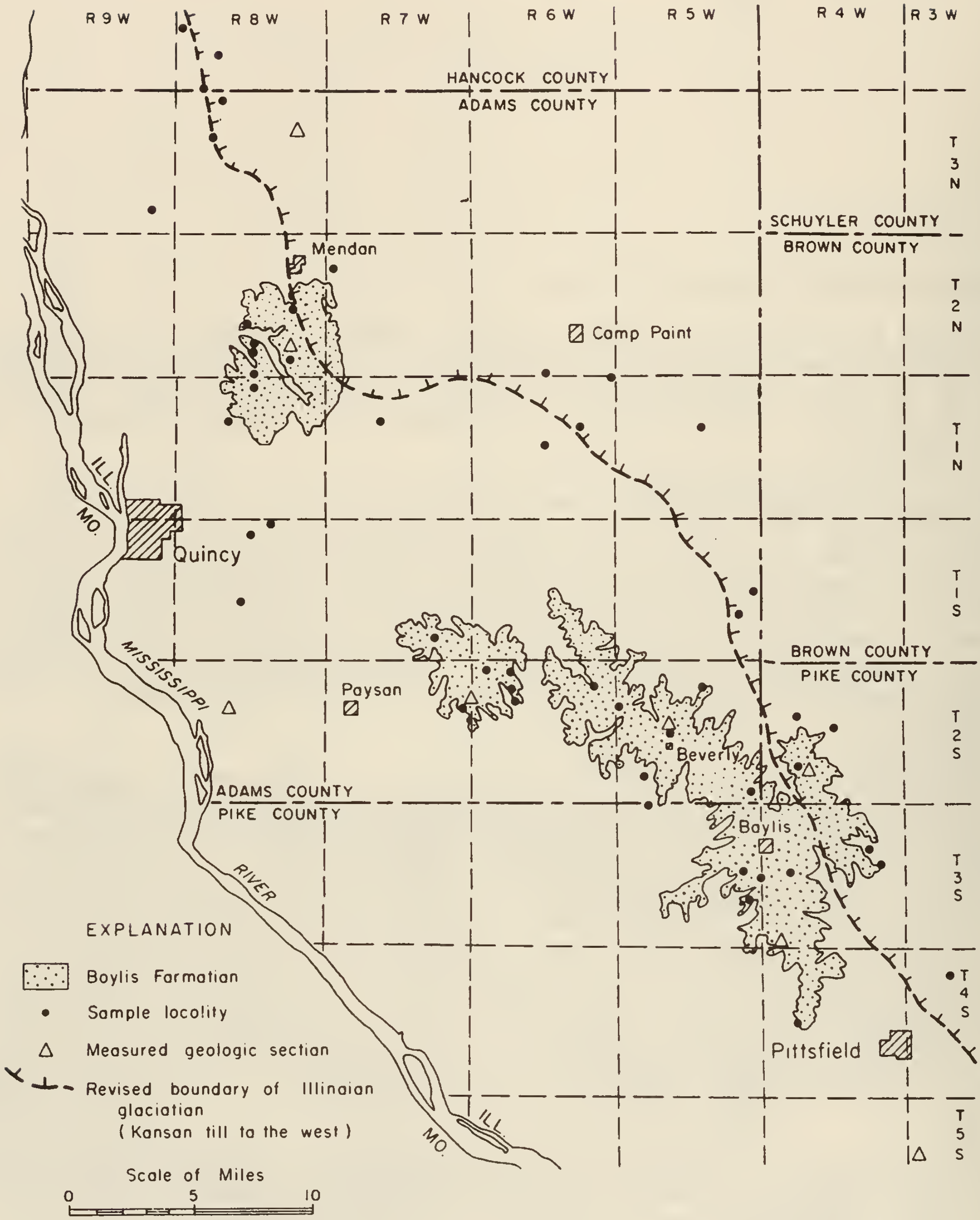


Figure 3. Map showing the distribution of the Baylis Formation of Cretaceous age in western Illinois, the boundary of Illinoian glaciation, and the locations of samples and geologic sections.

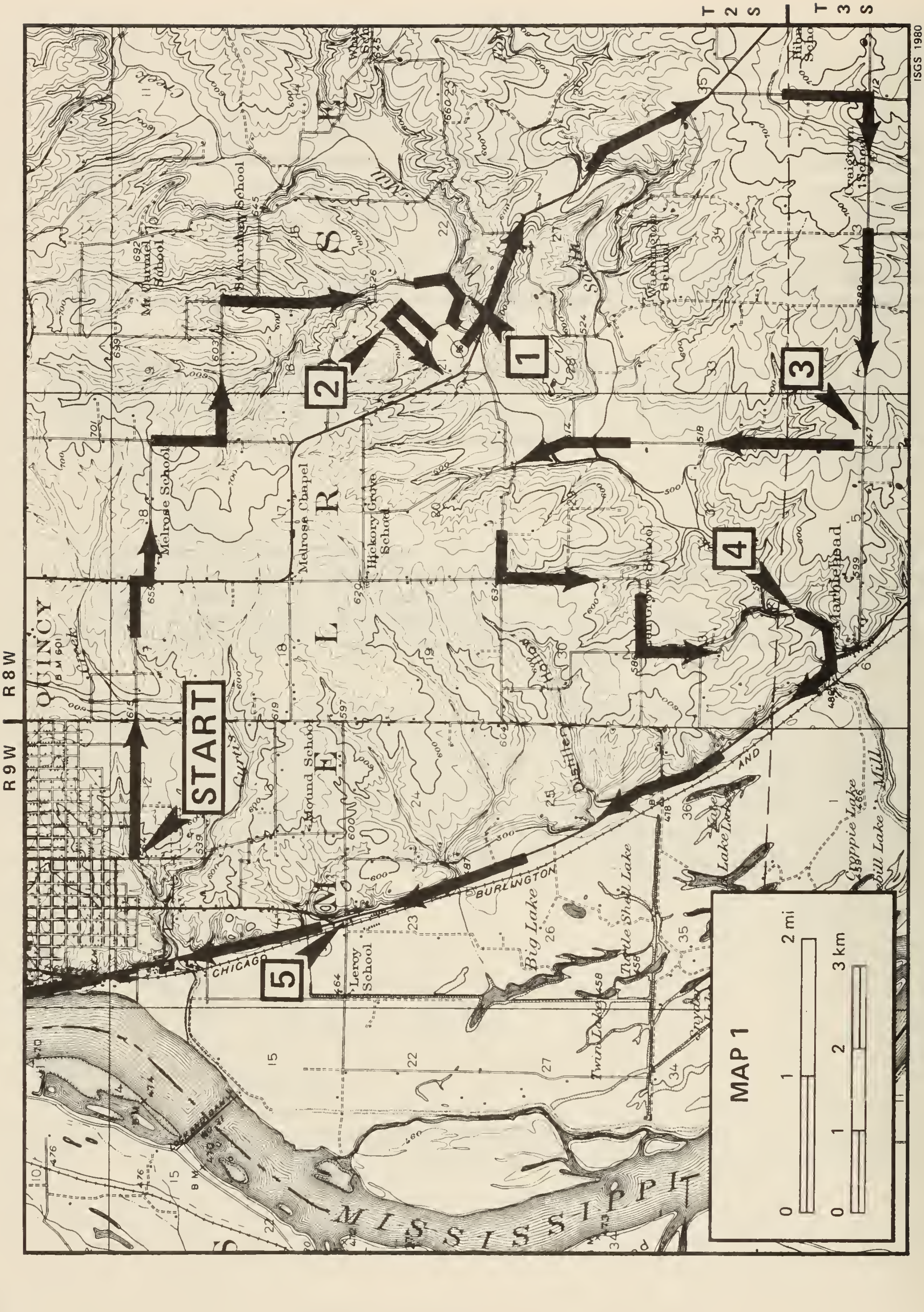
Paleozoic Era, it was gradually filled with Paleozoic sediments that eventually were altered to bedrock. These strata thicken to more than 13,000 feet in the deepest part of the basin, located in extreme southeastern Illinois. Pennsylvanian strata, deposited from 320 to 280 million years ago, are the youngest strata known from the basin and may represent the last of the marine invasions during the Paleozoic Era. On the other hand, marine conditions may have persisted into the Permian Period, which marks the close of the Paleozoic Era, with the sea withdrawing for the last time about 225 million years ago. Since then most of the region has been above sea level and exposed to erosion. During this long interval of erosion, all of the Permian strata and a considerable thickness of Pennsylvanian and older strata were removed. Pennsylvanian rocks are exposed just a few miles east of the field trip area.

In the northern part of the field trip area, Cretaceous sands and gravels are exposed along a topographic high area passing southeastward into Pike County (fig. 3). These deposits are isolated from known Cretaceous sediments about 200 miles to the west in Iowa and about 240 miles to the south in extreme southern Illinois.

Mineral resources

In 1978, the last year for which totals are available, mineral materials mined in Illinois were worth approximately $1,637,000,000. Stone, sand and gravel, and crude oil are the mineral materials produced in Adams County. In addition, iron oxide pigments are processed here. Adams County ranked 39th among the 98 mineral producing and processing counties in 1978, with a value of $8,831,000.

Sixty Illinois Counties with 271 quarries produced about 62,456,000 tons of crushed stone valued at $160,475,000. Adams County ranked 9th among the Illinois stone-producing counties; 8 quarries produced 955,309 tons valued at $8,208,859. Fifty-nine counties having 197 operations owned by 172 companies produced 37,700,000 tons of common sand and gravel valued at $83,694,000. One company produces sand and gravel in Adams County. Less than 3,000 barrels of crude oil were produced from the southeastern part of the county during the year.


MAP 1
R 9 W
R 8 W
T 2 S
T 3 S
START
1
2
3
4
5
QUINCY
MISSISSIPPI
Melrose School
Melrose Chapel
Hickory Grove School
St Anthony School
Mt Carmel School
Mound School
Leroy School
Big Lake
Turtle Shell Lake
Twin Lakes
Crappie Lake
Bull Lake
Marblehead
Craigtown School
Washington School
CHICAGO
BURLINGTON
AND
0 1 2 mi
0 1 2 3 km
ISGS 1980

guide to the route

The field trip begins in the south part of Quincy at the main shelter house of South Park. Mileage figures begin northeast of the shelter house at the intersection of Harrison and South 12th Streets.

Main Shelter House (SE 1/4 SW 1/4 NE 1/4 SE 1/4 Sec. 11, T. 2 S., R. 9 W., 4th P.M. Quincy West 7.5-minute Quadrangle). A little more than 400 feet south is Curtis Creek which has eroded its bed down into the fossiliferous Mississippian Burlington Limestone.

Miles to next point	Miles from starting point	
0.0	0.0	CAUTION. leave South Park heading east on Harrison Street. STOP at 12th Street.
1.0	1.0	STOP at South 24th Street. CONTINUE AHEAD (east).
1.0	2.0	STOP at South 36th Street and State Route (SR) 96. TURN RIGHT (south) and prepare to turn left.
0.1	2.1	TURN LEFT (east) on blacktop road (1050 N).
1.0	3.1	STOP, 1-way (900 E). TURN RIGHT (south) for 0.5 mile.
0.5	3.6	TURN LEFT (east) on gravel road (1000 N).
0.35	3.95	CAUTION, narrow bridge.
0.4	4.35	Cross SR-336 overpass.
0.25	4.6	TURN RIGHT (south) past St. Anthony's Church.
0.5	5.1	To the LEFT note the large slump block that has slid down and rotated toward the creek. Note how the trees have been skewed. CONTINUE AHEAD and cross creek.

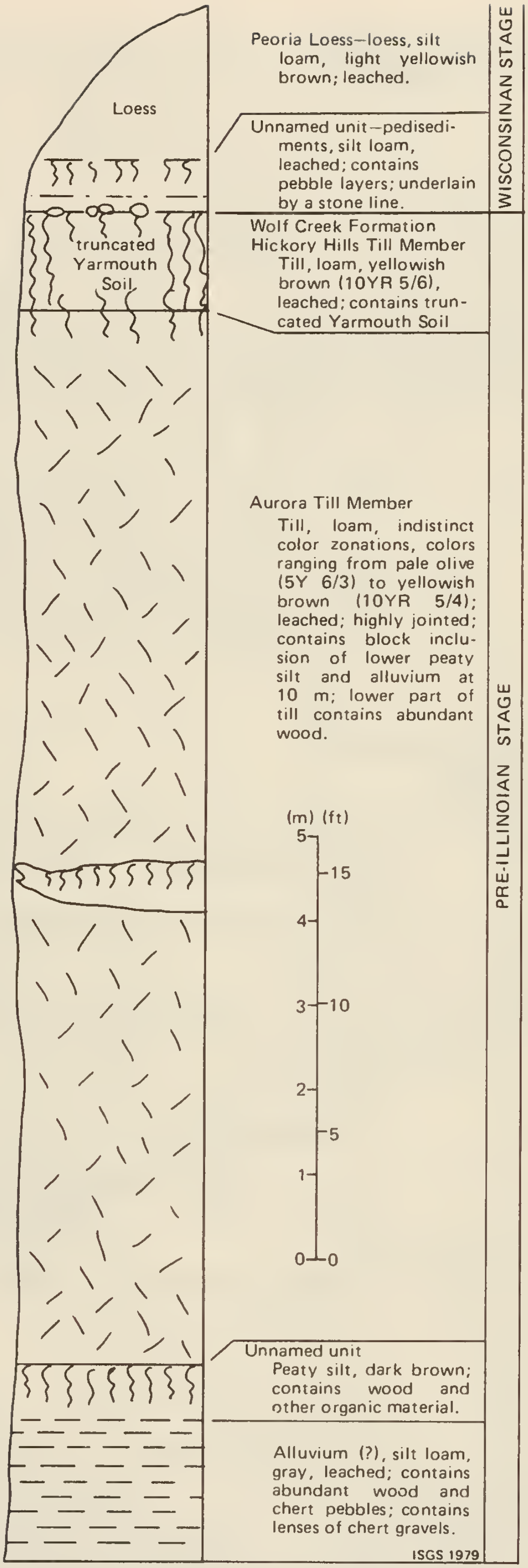


Figure 4. Stop 1. Mill Creek Section.

0.4	5.5	Cross creek. Note weathered Burlington Limestone exposed in the roadcut to the right.
0.1	5.6	To the RIGHT, just west of the fence corner with the "KEEP OUT" sign, is Wand Spring flowing out from the Burlington Limestone. Watercress formerly was raised here as a cash crop for the local market. CONTINUE AHEAD (south).
0.75	6.35	CAUTION. Pull off the road on the right shoulder south of Halfpap's Mobile Home Park. Do NOT block the driveway. Use CAUTION in crossing the road to the south side. The exposure is on the south side of Mill Creek about 300 feet south of the Mobile Home Park entrance.

STOP 1

Pleistocene deposits of the Mill Creek Section (SW 1/4 NW 1/4 SW 1/4 Sec. 22, T. 2 S., R. 8 W., 4th P.M. Quincy East 7.5-minute Quadrangle).

The following discussion is adapted from J. T. Wickham (1979).

The large exposures of Pleistocene deposits that occur along Mill Creek are subject to frequent large-scale slumping. The lower part of the section exposed here is unstable and different parts of the exposure have periodically been exposed and then later slumped over (fig. 4).

Although this is one of the larger Pleistocene sections exposed in this area, it does not have all of the stratigraphic elements present. Several units are missing from the upper part of this section. Slightly less than 8 feet of Peoria Loess are exposed at the top of the bluff. Found locally beneath the loess is a zone of material (pedisediments) deposited on the underlying erosion surface during the slope-forming process. The Peoria Loess and locally the pedisediments occur above a stone line that represents an erosion surface. Although the exact date of the erosion cycle represented cannot be determined, an approximate age is possible. In this part of Illinois, the Illinoian Loveland Silt, Sangamon Soil, and Wisconsinan Roxana Silt occur between the Peoria Loess and the underlying Pre-Illinoian deposits. Since these units are missing here, the erosion cycle must have taken place sometime after the Roxana Silt was deposited and before the Peoria Loess was deposited. Roxana deposition appears to have ceased about 30,000 radiocarbon years B.P. (before present) (McKay, 1979). In the upper Mississippi Valley region the Peoria Loess was deposited between about 20,000 and 13,000 radiocarbon years B.P. The erosion cycle, therefore, must have occurred sometime between approximately 30,000 and 20,000 radiocarbon years B.P.

It appears that part of the underlying Pre-Illinoian Wolf Creek Formation was eroded in the erosion cycle mentioned above. The uppermost Hickory Hills

Till Member is quite thin here when compared with other sections nearby. A Yarmouth Soil profile was developed down through the Hickory Hills Till Member into the underlying Aurora Till Member. The Hickory Hills is more sandy than the Aurora, which is quite silty; the Aurora is also more gray than the Hickory Hills.

Beneath the Wolf Creek Formation is a complex zone of organic silts that may be nearly 10 feet thick. Underlying the organic silts is a leached silty loam that extends to the creek bed where the Mississippian Burlington Limestone is exposed. The loam is a poorly sorted material thought to be alluvium, although it resembles glacial till. Occasional igneous pebbles, considerable wood debris, and much chert is present in this deposit. Isolated chert pebble and cobble bodies resemble gravel bars, suggesting that the material was deposited by a stream.

Another gap in the geologic record is apparent when the lower part of this exposure is examined. The oldest unconsolidated deposits here, probably less than a million years old, were deposited when the region stood well above sea level; however, the underlying Burlington Limestone was deposited in a warm, shallow sea that covered the Midcontinent Region during the Mississippian Period, some 340-335 million years ago. As mentioned previously, an unknown thickness of younger Mississippian, Pennsylvanian, perhaps Permian, and Cretaceous sediments was eroded away before the first glaciers slowly flowed across the region more than a million years ago.

Miles to next point	Miles from starting point	
0.0	6.35	Leave Stop 1. CONTINUE AHEAD (west).
0.4	6.75	STOP. TURN RIGHT (north) onto SR 96 and prepare to turn right again.
0.1	6.85	TURN RIGHT (easterly) on approach to SR 336.
0.3	7.15	CAUTION. Enter SR 336 and move to the inside (left) lane as soon as possible.
0.3	7.45	Prepare to turn left.
0.2	7.65	CAUTION. TURN LEFT (west) at gravel cross-over to southbound lanes. NOTE: keep in LEFT lane on the gravel cross-over and TURN LEFT (south) on to the blacktop emergency parking strip. PARK as close to the edge of the parking strip as possible; leave your vehicle ONLY on the DRIVER'S SIDE. CAUTION: Cross to the west side of the highway and walk north about 400 feet to the exposure.

STOP **2**

Glacial deposits and sinkholes in SR 336 roadcut (SE 1/4 SE 1/4 SE 1/4 Sec. 16, T. 2 S., R. 8 W., 4th P.M. Quincy East 7.5-minute Quadrangle). The following discussion is adapted from the Wand Spring Section of J. T. Wickham (1979).

This roadcut through the Burlington Limestone shows the solution effects of percolating groundwater on jointed, soluble bedrock strata covered by glacial deposits and soil layers (fig. 5). The larger sinkholes and open joints are filled with dark red clay and chert residuum, characteristic residual deposits left behind from intense chemical weathering of a cherty limestone. Sand is also present in some of the fillings. None of these materials occurs above the bedrock surface here, indicating that they were in place before glaciation and that the glaciers did not excavate the small sinkhole depressions to remove these deposits. Instead, some of the sinkholes are partially blocked at the top by jumbled bedrock blocks. Some of the blocks may have been ripped from the bedrock surface by the overriding glaciers and then smeared into the sinkholes.

Do you suppose that surface water percolating downward through these glacial deposits and moving downward and laterally through the Burlington Limestone might be coming out of the hillside at Wand Spring a little more than 0.15 miles east-southeast of this locality? Would you expect this water to have been filtered much in passing through this bedrock unit? Why?

Glacial deposits near the north end of the roadcut truncate the upper part of the bedrock (fig. 5). Part of the section shown in figure 6 is within the large sinkhole extending downward from this till section. The Pleistocene deposits here are correlated with the Aurora Till Member of the Pre-Illinoian Wolf Creek Formation also observed at Stop 1.

Miles to next point	Miles from starting point	
0.0	7.65	Leave Stop 2. CAUTION: CONTINUE AHEAD (southerly) and move into the outside (right) lane as soon as possible.
0.4	8.05	BEAR RIGHT (westerly) at exit ramp from SR 336 toward SR 96.
0.4	8.45	STOP. TURN LEFT (south) on SR 96.
0.1	8.55	Cross SR 336 overpass and CONTINUE AHEAD (south).
0.25	8.8	Cross Mill Creek.
1.15	9.95	Cross Burton Creek. Burlington Limestone is exposed to the left in the creek.

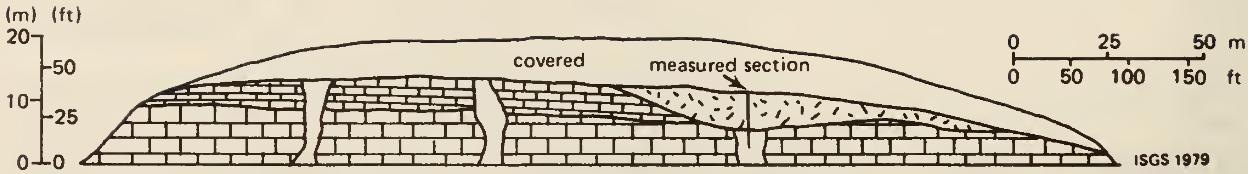


Figure 5. Diagram of Wand Spring Section. Datum is road level.

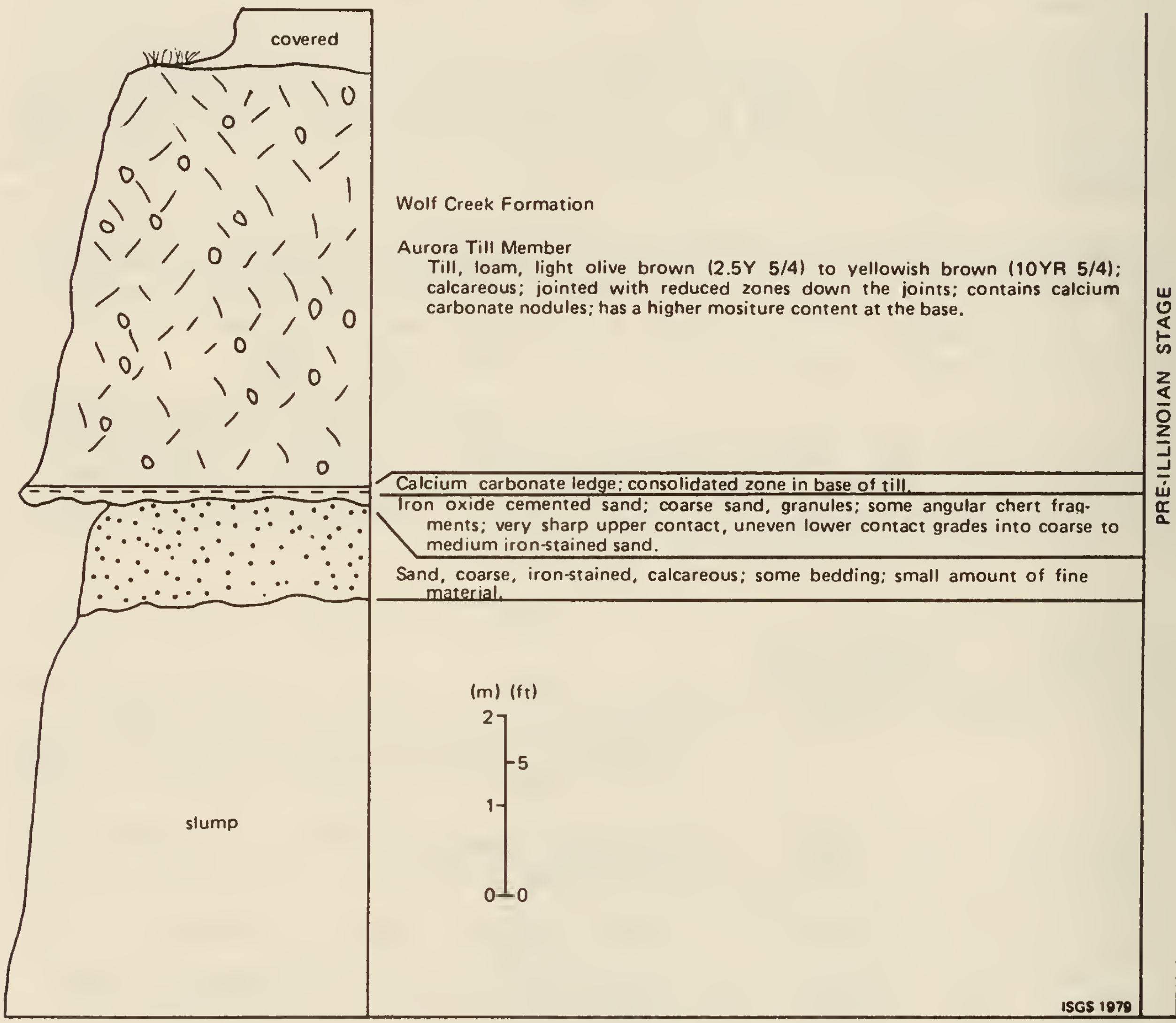


Figure 6. Stop 7. Wand Spring Section.

1.2	11.15	Prepare to turn right.
0.2	11.35	TURN RIGHT (south) on the gravel road across from the Haunted Tavern.
1.1	12.45	STOP at crossroads. Slightly to the left the higher part of the Kansan till plain extends more than 2 miles southeast to Payson. TURN RIGHT and head west for 2.5 miles.
2.0	14.45	Panoramic view to left (south) and straight ahead (west) toward the Mississippi River valley. View from the partially dissected Kansan till plains down across the rugged dissected till plains to the river valley.
0.35	14.8	Park to the right as far as possible without getting in the ditch.

STOP

3

Sinkhole to the right (north). (SE 1/4 SW 1/4 NW 1/4 Sec. 4, T. 3 S., R. 8 W., 4th P.M. Marblehead 7.5-minute Quadrangle).

On the uplands in this vicinity there are several circular depressions called sinkholes. To the right about 500 feet is a large sinkhole that frequently has water standing in the bottom. We will pass several others in a short while after we leave this stop.

A landscape with numerous sinkholes is known as karst topography. Sinkholes develop in regions that are underlain by thick, highly jointed limestone. Downward percolating rainwater takes up organic acids from the soils, enters the joints, and dissolves the limestone. As time passes, underground drainage increases, and a network of subterranean channels and caverns is formed. Sinkholes are formed both by surface solution and by collapse of the roofs of near-surface caverns.

Four conditions contribute to the development of karst topography. (1) There must be at or near the surface a soluble rock, such as limestone, and the limestone should be flat-lying or nearly so. (2) The limestone should be dense, highly jointed, and preferably thinly bedded. The limestone should not be porous, because under such conditions the rainwater would be absorbed and move through the whole body of the rock, rather than be concentrated along joints and bedding planes to form channels and caverns. These first two conditions are satisfied by the Mississippian limestone strata underlying the uplands in the Quincy area. (3) There must be entrenched major stream valleys below the uplands. These valleys act as outlets toward which the ground water can move in the subsurface. The Mississippi River satisfies this condition. (4) There must be ample rainfall.

Miles to next point	Miles from starting point	
0.0	14.8	Leave Stop 3. CONTINUE AHEAD (west) and prepare to turn right.
0.15	14.95	TURN RIGHT (north) at crossroads (903 E).
0.2	15.15	The depression to the north of the farmhouse on the right was a waterfilled sinkhole until a ditch was dug into it to drain it.
0.1	15.25	North of the house on the left is a water-filled sinkhole.
1.2	16.45	To the right is a low terrace in the field.
0.45	16.9	CAUTION. One-lane bridge across Burton Creek.
0.1	17.0	You are crossing the terrace level noted previously.
0.05	17.05	T-road from right. CONTINUE STRAIGHT AHEAD (north).
0.05	17.1	The low mound to the right in the field is a sand dune.
0.1	17.2	CAUTION. Cross Mill Creek on one-lane bridge.
0.3	17.5	T-road from left. TURN LEFT (west) on 800 N across from the Country Store. On the northwest side of the intersection and about 100 feet west of the road is Cole Spring on the west side of the creek.
0.85	18.35	STOP. TURN LEFT (south) on blacktop.
1.05	19.4	On the right overgrazing has ruined the sod cover, facilitating rapid gullying of the slope.
0.4	19.8	Crossroad. TURN LEFT (south) on gravel road.
1.3	21.1	Park on west side of road close to the ditch across from the entrance gate of Adams Stone and Materials Company. Walk to the office to get permission for entering this property. CAUTION in crossing the one-lane bridge.

STOP 4

Quarry in Mississippian Burlington Limestone (S 1/2 SE 1/4 SE 1/4 Sec. 31, T. 2 S., R. 8 W., 4th P.M. Marblehead 7.5-minute Quadrangle).

Marblehead Lime Company opened this quarry in the 1880s and operated it until 1920. Much of its production was from adits driven back into the hillside in the high purity "Quincy Lime." Portions of several of these old adits are now used for storage and shop facilities by the present owners. In the late 1920s and early 1930s the former owners sank a shaft down through the underlying Hannibal Shale into the Louisiana Limestone and used this stone for the manufacture of rock wool for a short time. Much of the stone used in the construction of Lock and Dam 21 at Quincy came from this quarry. The quarry was dormant from the late 1930s until 1975 when Adams Stone and Materials Company purchased the property and reopened the quarry.

The Burlington Limestone is composed of massive- to thick-bedded, coarse- to medium-grained, highly fossiliferous limestone which generally is more than 80 feet thick in the subsurface throughout this area. The top 20 to 40 feet (coarse-grained, very fossiliferous, glauconitic, and slightly cherty) is called the Cedar Fork Member. The middle 30 to 50 feet, a medium-grained limestone locally interbedded with dolomitic limestone and thin shale partings, contains some glauconite and some chert nodules and beds. This limestone is called the Haight Creek Member. The lower part of the Burlington (the Dolbee Creek Member) is an exceptionally pure, white, coarse-grained, thick- to massive-bedded, stylolitic limestone 10 to 40 feet thick containing chert beds and nodules, especially in the upper part. The "Quincy Lime" is contained in the Dolbee Creek Member.

About 60 feet of the Burlington is exposed in this quarry. The upper 25 to 30 feet has a high chert content and is used mainly for the base course in road construction. The less cherty parts of the quarry are used for agstone and for construction aggregates. Crinoid and brachiopod remains are common in the limestone here.

Miles to next point	Miles from starting point	
0.0	21.1	Leave Stop 4. CONTINUE AHEAD (south and west).
0.5	21.6	STOP. TURN LEFT (northerly) on SR 57.
0.05	21.65	Burlington Limestone containing pronounced chert masses is exposed to the right.
3.1	24.75	CAUTION. Enter underground mine area of Calcium Carbonate Company, Plant No. 3. Note adits into the Burlington Limestone in the bluff to the right.
0.55	25.3	CAUTION. Railroad crossing. CONTINUE AHEAD (north) and prepare to turn right.
0.15	25.45	CAUTION. BEAR RIGHT (northerly).
0.05	25.5	PARK to the left close to the north entrance to SR 57 from the Underground Warehouse area.

STOP

5

Storage facilities of Underground Warehouse, Inc. (NE 1/4 NW 1/4 NE 1/4 Sec. 23, T. 2 S., R. 9 W., 4th P.M. Quincy West 7.5-minute Quadrangle). NOTE: We will not enter the facilities here. BE ALERT for traffic moving in and out of this facility.

Calcium Carbonate Company, a division of the Huber Corporation, started operations here in 1918. The adits into the bluff on the east side of the Mississippi Valley open into four different quarries owned and operated by this company. Three of the quarries are connected underground so that it is possible to travel about a mile from north to south in the mine. The works extend about 1/4 mile back into the bluff from the face. The lower, more pure Dolbee Creek Member ("Quincy Lime") of the Burlington Limestone is mined in this vicinity. The mined portion here is 28 feet thick and the quarries have a "soapstone" floor, the Hannibal Shale. Temperature in the mines is a constant 60^{o}F.

This high purity limestone is used in the manufacture of rubber, putty, plasterboard (drywall), paint, plastics, floor tile, animal feed supplements , and blacktop for roads. As much as 30 carloads a week are used for the white filler in the manufacture of floor tiles.

The Underground Warehouse, opened in 1969, is the only facility of its kind in Illinois at the present, and is an excellent example of sequential land use. There are actually six separate warehouses here that extend back about 1/4 mile from the bluff face. One room has an area of 5.25 acres. The warehouse is served by two railroad tracks and also has facilities for handling trucks. Commodities stored here include beer, musical organs, sugar, air filters, thermos equipment and products, and tires. The constant temperature and humidity are ideal for storing these products.

Miles to next point	Miles from starting point	
0.0	25.5	STOP. BEAR RIGHT (northerly) on SR 57.
1.7	27.2	Intersection with Jackson Street. The building to the right on the northeast corner of the intersection is constructed of native stone from this area. It is owned by the Sass Brothers Pattern Shop, Inc. CONTINUE AHEAD (north) and prepare to turn left.
0.35	27.55	STOPLIGHT at Jefferson Street. CAUTION. TURN LEFT (west) and cross two railroad tracks.
0.05	27.6	STOP. TURN RIGHT (north) on Great River Road. CAUTION. This is an industrial area.

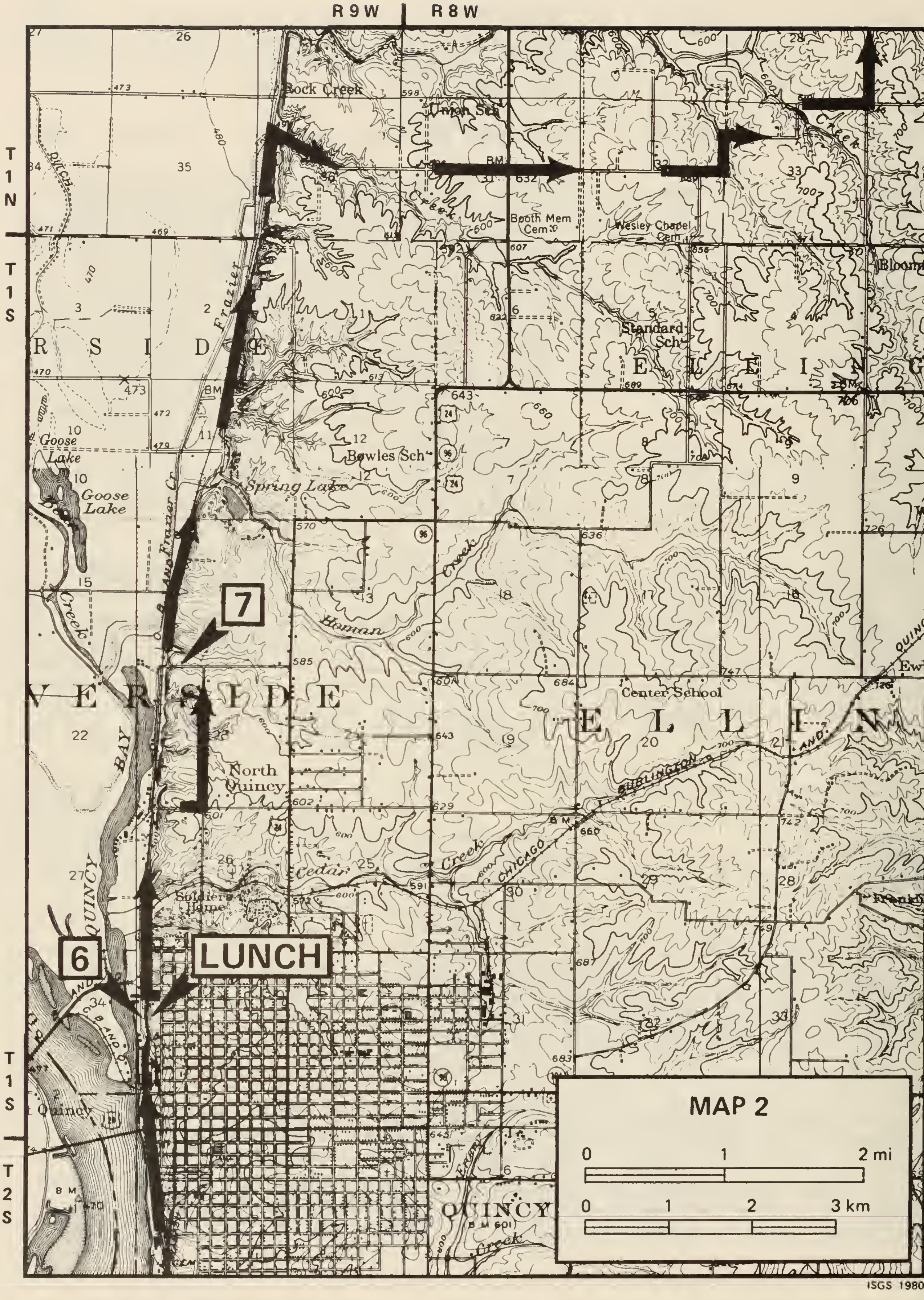
0.15	27.75	Slightly to the right (north-northeast) on the bluff is a mosque-type structure, the Villa Katherine, now abandoned but located in a park of the same name.
0.6	28.35	Go under the Mississippi River highway bridge.
0.25	28.6	STOP. The Quincy Sand Company is located to the left at the foot of Broadway. This company uses a dredge to win sand from river bars; the material is sized on the dredge and then loaded on to an accompanying barge. The over- and under-sized material is discharged into the river. The barge is towed in to the loading facility here, where it is loaded into the overhead hoppers for easy truck loading. TURN RIGHT (east) on Broadway and ascend the hill to just beyond the Burlington Northern (BN) Railroad trestle.
0.1	28.7	TURN LEFT (north) on North 2nd Street.
0.5	29.2	TURN LEFT (west) at Chestnut Street entrance to Riverview Park and BEAR RIGHT.
0.05	29.25	Memorial statue of General George Rogers Clark on the right. CONTINUE AHEAD (west and north).
0.1	29.35	PARK along curb. LUNCH. After lunch assemble at the overlook on the west side of the street.

STOP 6

Overview and discussion of the Mississippi River Valley (Near C W 1/2 SW 1/4 SW 1/4 NW 1/4 Sec. 35, T. 1 S., R. 9 W., 4th P.M. Quincy West 7.5-minute Quadrangle).

The Mississippi River Valley, the most prominent topographic feature in the field trip area, is approximately 6 miles wide. The bedrock floor of the valley is less than 300 feet mean sea level (m.s.l.) while the surface of the floodplain here is about 470 feet m.s.l. There is, therefore, a considerable amount of valley fill in this vicinity.

The Mississippi River we see today south of the Rock Island area generally follows a large preglacial valley southward to its juncture with the present Illinois River. Prior to the diversion during Wisconsinan time, this large valley was occupied by the preglacial Iowa River, which appears to have headed in southern Minnesota and flowed southward across eastern Iowa to Muscatine, where it turned southward. The Ancient Mississippi River, on the



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Wesley Chapel Cem
Standard Sch
Goose Lake
Spring Lake
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Homan
Center School
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other hand, followed its present course along what is now northwestern Illinois to the vicinity of Fulton, where it swung southeastward toward Princeton and the present "Big Bend" of the Illinois River. From the Big Bend southward, the Ancient Mississippi essentially followed the present Illinois River course to Calhoun County where it was joined by the preglacial Iowa River.

The valley is entrenched 200 to 500 feet below the adjacent bedrock uplands, here largely into fairly resistant Mississippian limestone strata which have helped to maintain a relatively narrow, steep-walled configuration.

Although both the preglacial Iowa River and the Ancient Mississippi River may have formed before glacial times, their valleys were deepened and widened by meltwaters from the Nebraskan and Kansan glaciers. Deposits attributable to these periods of glaciation have been found in the deeper parts of the bedrock valleys. During the Illinoian glaciation, the preglacial Iowa River was again forced from its valley to a westerly course in Iowa. However, this Illinoian diversion was only temporary, and when the ice had melted away the river resumed its older southward course. Tremendous volumes of meltwater from the receding Illinoian glacier and the later Wisconsinan glaciers removed any Illinoian glacial deposits that were in the valley. During the Woodfordian advance of the Wisconsinan glaciation (note small maps in the attached *Pleistocene glaciations in Illinois*), the Ancient Mississippi River was forced westward and permanently diverted into the preglacial Iowa Valley when meltwater over-topped a bedrock divide at Cordova in Rock Island County. The Ancient Mississippi Valley to the Big Bend was buried by drift and permanently abandoned. The Illinois River then assumed the valley of the Ancient Mississippi southward to southern Calhoun County.

Miles to next point	Miles from starting point	
0.0	29.35	Leave Stop 6. CONTINUE AHEAD (north).
0.05	29.4	BEAR LEFT (northerly) down the hill.
0.1	29.5	The slumped loess to the right over the stone retaining wall is the result of children's digging in it farther up the slope.
0.1	29.6	STOP. TURN LEFT (west) on Cedar Street.
0.2	29.8	STOP just beyond BNRR overpass. TURN RIGHT (north) on the Great River Road.
0.15	29.95	CAUTION. Guarded BNRR crossing.
0.35	30.3	BNRR trestle above. CAUTION. Road is wavy ahead.

0.2	30.5	CAUTION. Jog right and then left across unguarded BNRR crossing.
0.35	30.85	Abandoned quarry and cave adits in the Burlington Limestone to the right in Lenane Park.
0.15	31.0	TURN RIGHT (east) and ascend hill on Bluff Road (1400 N).
0.35	31.35	STOP. TURN LEFT (north) on North 5th Street.
1.0	32.35	STOP. TURN LEFT (west) on 1500 N. Prepare to stop near the crest of the bluff.
0.2	32.55	PARK to the right as far as possible so that you <u>have</u> to get out on the driver's side.

STOP 7

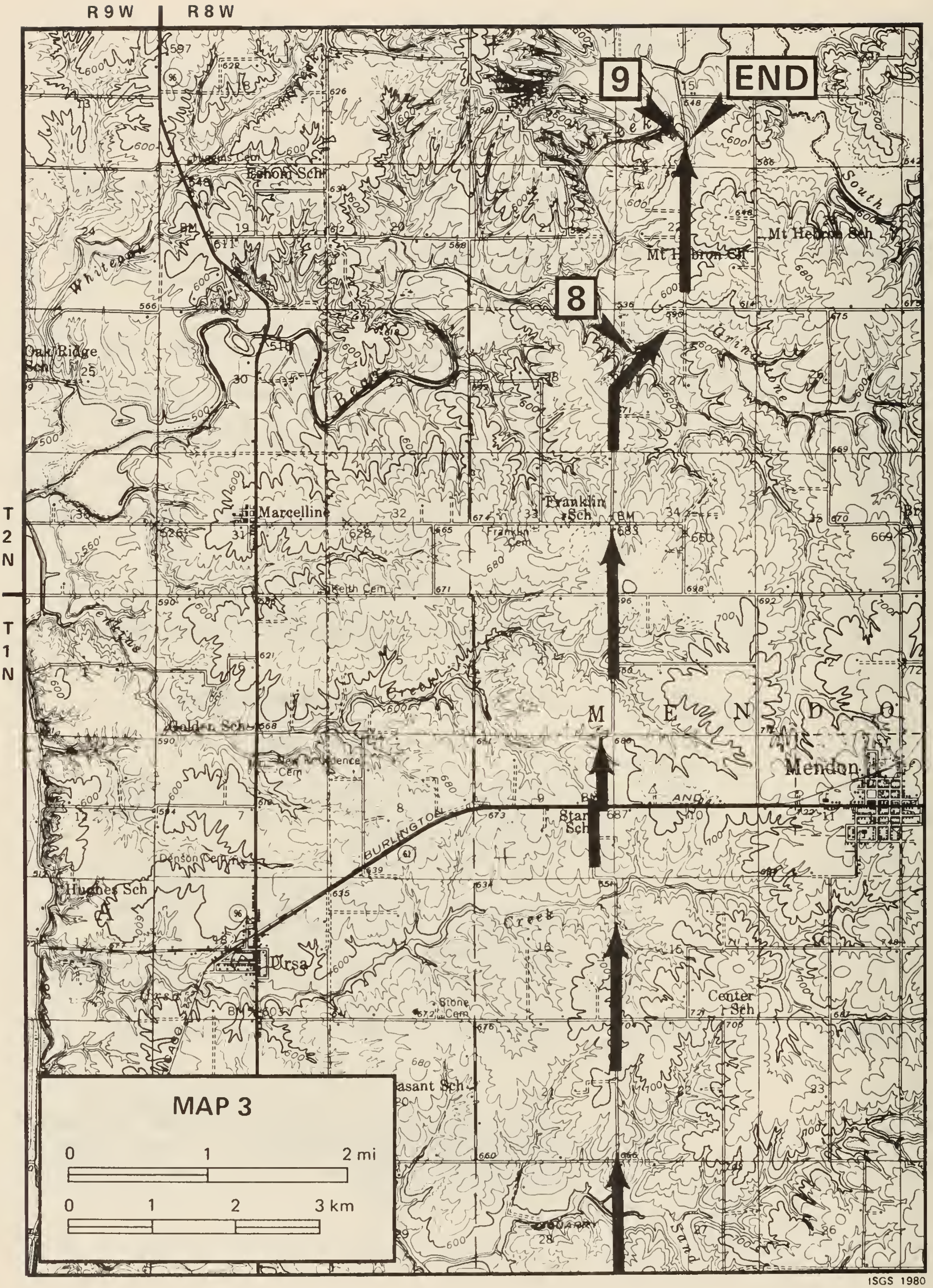
North Quincy loess section (NW 1/4 NE 1/4 NW 1/4 Sec. 23, T. 1 S., R. 9 W., 4th P.M. Quincy West 7.5-minute Quadrangle).

NORTH QUINCY SECTION

Measured in roadcuts in NW 1/4 NE 1/4 NW 1/4 Sec. 23, T. 1 S., R. 9 W., Adams County, Illinois, 1961.

	Thickness (feet)
Pleistocene Series	
Wisconsinan Stage	
Woodfordian Substage	
Peoria Loess - surface soil developed in top; loess below is yellow-tan, coarse, calcareous, massive, friable, and contains occasional fossils; becomes clayey and mottled gray and tan with brown spots in lower 9 feet.	37.0
Altonian Substage	
Roxana Silt - silt with some clay, purplish brown to tan-brown with slight pinkish cast in lower part, non-calcareous; becomes sandy and massive downward and contains some angular chert fragments.	4.0
Sangamonian Stage	
Illinoian Stage	
Sangamon Soil developed in sand and gravel, dark red with some gray and brown mottling, clayey, locally cemented; covered in lower part.	15.0
	56.0

Miles to next point	Miles from starting point	
0.0	32.55	Leave Stop 7. CONTINUE AHEAD (west).
0.05	32.6	STOP. TURN RIGHT (north) at foot of bluff.
1.3	33.9	Cross Homan Creek. Note alluvial deposits in the creek bank to the right.
1.55	35.45	Very cherty Keokuk Limestone that overlies the Burlington Limestone in roadcut to right.
0.95	36.4	Cross bridge and prepare to turn right.
0.05	36.45	TURN RIGHT (east) on gravel road (1850 N).
0.2	36.65	CAUTION. Sharp S-curve across narrow concrete bridge.
0.35	37.0	View to left of cascade over limestone outcrop in pasture.
0.1	37.1	Undercut limestone ledge to left.
1.05	38.15	STOP at SR 96. CONTINUE STRAIGHT AHEAD (east).
1.7	39.85	CAUTION. Narrow concrete bridge.
0.2	40.05	TURN RIGHT (east) on 1903 N.
0.65	40.7	Gravels exposed in the ditches here are Kansan in age and probably are reworked Cretaceous gravels. Occasional banded quartzite cobbles can be found along with abundant chert; occasional geodes; frequent siliceous masses that look somewhat like geodes correlated with certain fossil types; and occasional granite and other igneous rocks.
0.05	40.75	CAUTION. Narrow iron bridge over Rock Creek.
0.5	41.25	Small draw to the left (north) along the south edge of the feedlot shows Warsaw Shale containing geodes overlain by gravel, some of which may be reworked Cretaceous material.


R9W
R8W
T2N
T1N
9
END
8
MAP 3
0
1
2 mi
0
1
2
3 km
Oak Ridge Sch
Eshom Sch
Mt Hebron Sch
Mt Hebron Ch
Marcelline
Franklin Sch
Keith Cem
Golden Sch
MENDON
Mendon
Star Sch
BURLINGTON
Denson Cem
Hughes Sch
Ursa
Stone Cem
Center Sch
Creek
South
Whitney
ISGS 1980

0.05	41.3	CAUTION. Crossroads. TURN LEFT (north) on 1000 E.
0.6	41.9	Cross Sand Branch.
0.25	42.15	Warsaw limestone exposed in cut bank to right. Overlain by chert gravels. No igneous materials noted. May be Cretaceous gravels.
1.8	43.95	CAUTION. Narrow concrete bridge.
0.25	44.2	CAUTION. Narrow iron bridge. About 3 feet of gray Warsaw Shale is exposed in the creek on the right (east) side of the bridge.
0.75	44.95	STOP at SR 61. TURN RIGHT (east) and prepare to turn left.
0.05	45.0	TURN LEFT (north) on gravel road and immediately cross unguarded BNRR crossing.
0.5	45.5	TURN RIGHT (east).
0.1	45.6	TURN LEFT (north).
1.0	46.6	Jog left and then right at 2400 N.
1.8	48.4	PARK to right; do not block driveway.

STOP

8

Abandoned quarry in limestone and shale of the Warsaw. (N 1/2 SW 1/4 NW 1/4 Sec. 27, T. 2 N., R. 8 W., 4th P.M. Mendon 15-minute Quadrangle). You MUST have permission to enter this area. Walk west down the lane to the quarry on the south side of Grindstone Creek.

The quarry face exposes about 30 feet of cherty and shaly limestone of the Warsaw. From the quarry floor to the creek, about 4 feet, the shaly limestone is interbedded with purer fossiliferous limestone which may constitute a gradation from the Warsaw above to the underlying Keokuk Limestone.

The quarry floor represents a moment in Mississippian time. It is covered with the shells of the ancient sea life which lived there more than 330 million years ago. Several kinds of brachiopods are abundant as are portions of crinoid stems.

The Warsaw in western central Illinois and adjacent states is characterized by an abundance of geodes—roughly rounded masses of chalcedony and quartz found throughout the shaly limestone. Many of the geodes are hollow and are lined with crystals of quartz and other minerals. The majority of the geodes here in the quarry are solid chalcedony. Best collecting areas are along Grindstone Creek 1/2 mile above and below the quarry. (NOTE: you MUST obtain permission from the various property owners to collect in those localities too).

Miles to next point	Miles from starting point	
0.0	48.4	Leave Stop 8. CONTINUE AHEAD (northeast).
0.3	48.7	T-road intersection. TURN LEFT (north) on 1350 E and immediately cross narrow concrete bridge over Grindstone Creek.
0.9	49.6	Note the gentle walls of the valley into which we are descending. This fairly wide valley has a stream in it too small to have produced this size valley. This may have been a temporary course for Bear Creek at one time.
0.45	50.05	The north valley wall is steeper than the south. The north slope is supported by bedrock ledges of Mississippian St. Louis Limestone.
0.05	50.1	PARK along the east side of the road. Do NOT block the gate to the pig lot.

STOP 9

Discussion of Bear Creek drainage. (NW 1/4 SW 1/4 SE 1/4 Sec. 15, T. 2 N., R. 8 W., 4th P.M. Mendon 15-minute Quadrangle).

The St. Louis Limestone, which lies above the Warsaw, is exposed here as low ledges in the road and the barnyard. The view south and east is over an old valley remnant without a stream. The rounded contour of the valley walls gives the valley a mature appearance. The valley floor is in rock and lies at the same elevation (560 feet m.s.l.) as the terraces to the west at the mouth of Bear Creek. Bear Creek probably occupied this valley at the same time that it built the flood plain now represented by the terrace remnants several miles to the west where it joins the Mississippi Valley.

Later Bear Creek or a tributary working northward found part of an ancient, preglacial, drift-filled valley in the bedrock. There it was able to erode its channel downward more rapidly, so that in time it abandoned the rock-floored valley to the south.

END OF FIELD TRIP. Have a safe journey home.

Retrace route to SR 61 west of Mendon (5 miles), or continue ahead (north) for about 1.25 miles to the blacktop; turn left and follow 4 miles to 0.75 miles south of Lima, SR 96; or turn right (east) and follow blacktop 5.5 miles east and south to Loraine, thence south 1.5 miles to SR 61.

PROPERTY OWNERS

Stop 1: Mr. Sieg Halfpap, St. Anthony Road, R. R. 5, Quincy, IL 62301

Stop 4: Adams Stone and Materials Company, R. R. 5, Quincy, IL 62301

Stop 5: Underground Warehouse. Calcium Carbonate Company, Front and 8th Streets, Quincy, IL 62301

Stop 8: Mr. Henry R. Cannell, Mendon, IL 62351

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PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, the period of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. Ice sheets formed in sub-arctic regions four different times and spread outward until they covered the northern parts of Europe and North America. In North America the four glaciations, in order of occurrence from the oldest to the youngest, are called the Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

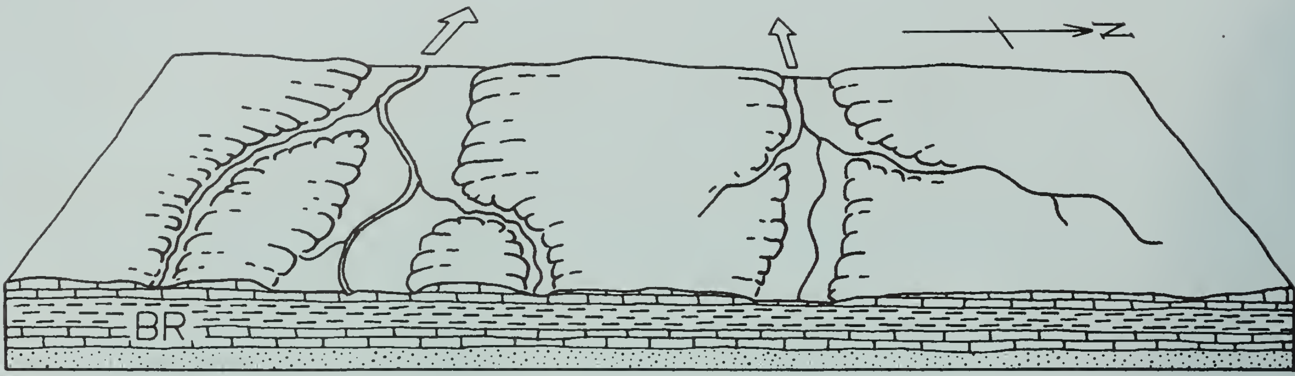
The North American ice sheets developed during periods when the mean annual temperature was perhaps 4° to 7° C (7° to 13° F) cooler than it is now and winter snows did not completely melt during the summers. Because the cooler periods lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

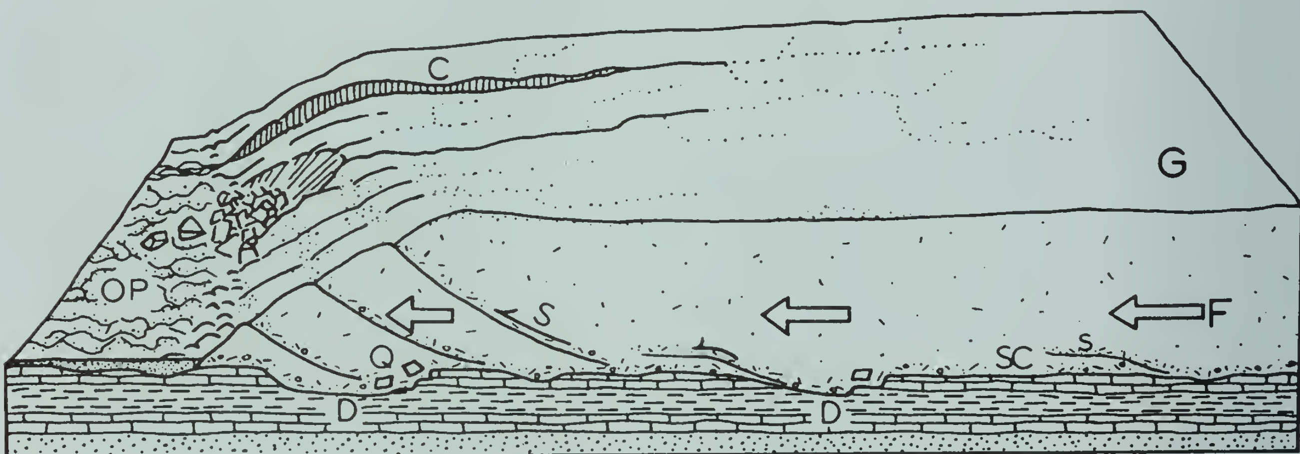
Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

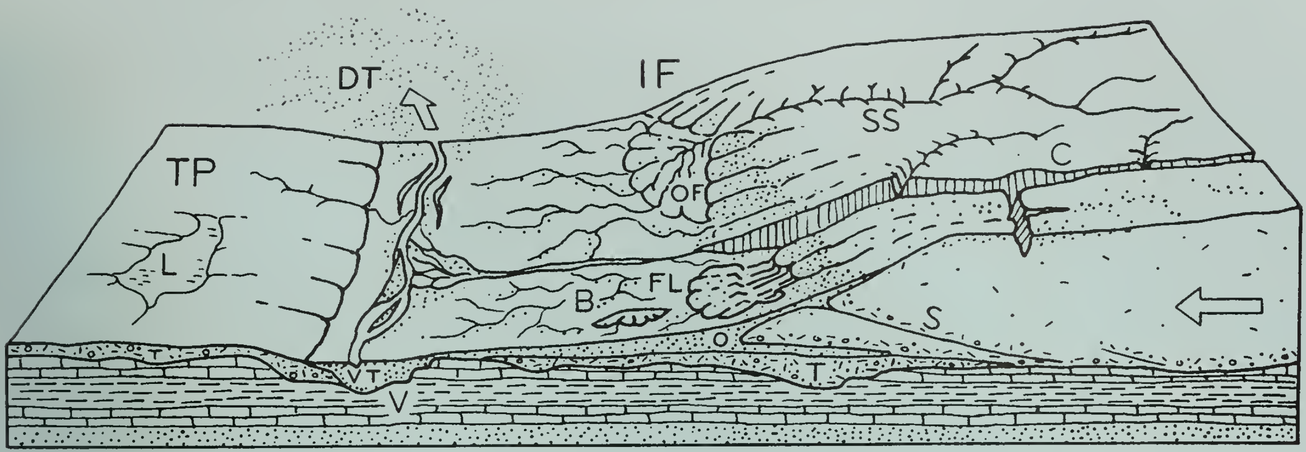
The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was probably enough to lower sea level more than 300 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.



1. The Region Before Glaciation - Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks--layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



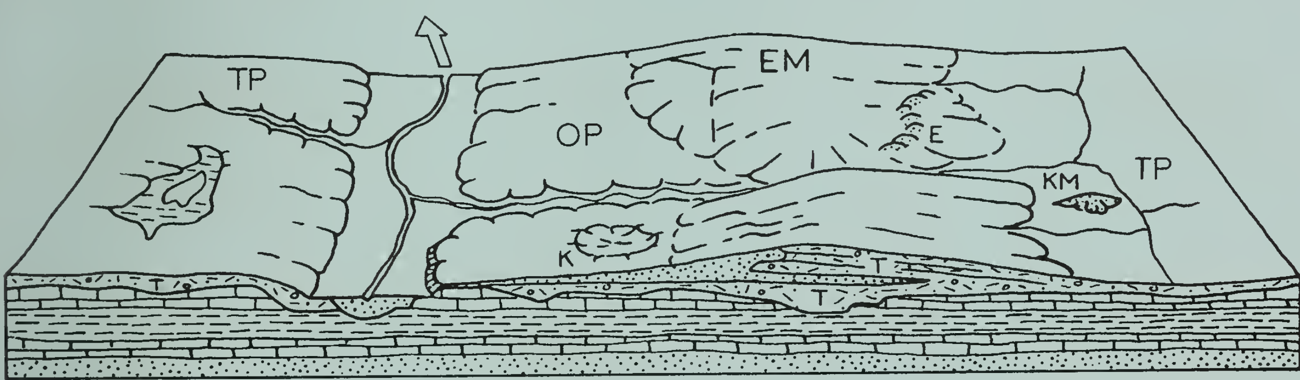
2. The Glacier Advances Southward - As the glacier (G) spreads out from its snowfield, it scours (SC) the soil and rock surface and quarries (Q)--pushes and plucks up--chunks of bedrock. These materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before the ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick , except near its margin. Its ice front advances perhaps as much as a third of a mile per year.



3. The Glacier Deposits an End Moraine - After the glacier advanced across the area, the climate warmed and the ice began to melt as fast as it advanced. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that was mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A superglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) was left as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remained a low spot in the terrain. As soon as its ice cover melted, meltwater drained down the valley, cutting it deeper. Later, outwash partly refilled the valley--the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles.



4. The Region after Glaciation - The climate has warmed even more, the whole ice sheet has melted, and the glaciation has ended. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

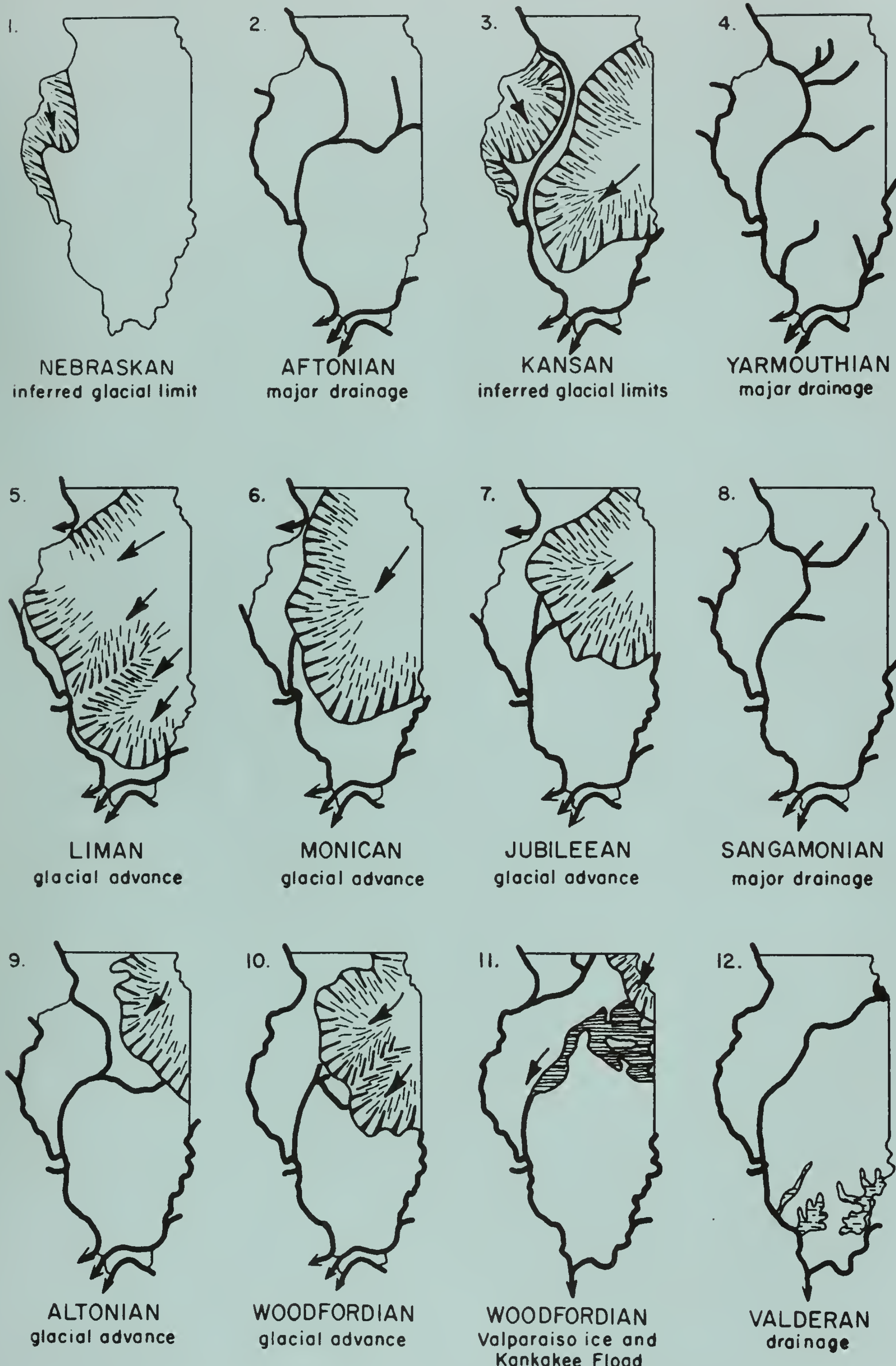
Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

TIME TABLE OF PLEISTOCENE GLACIATION

STAGE	SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
HOLOCENE	Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
	7,000		
WISCONSINAN (4th glacial)	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
	11,000		
	Twocreekan	Peat and alluvium	Ice withdrawal, erosion
	12,500		
	Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
	22,000		
	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
	28,000		
	Altonian	Drift, loess	Glaciation in northern Illinois, valley trains along major rivers
	75,000		
SANGAMONIAN (3rd interglacial)		Soil, mature profile of weathering	
	175,000		
ILLINOIAN (3rd glacial)	Jubileean	Drift, loess	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
	Monican	Drift, loess	
	Liman	Drift, loess	
	300,000		
YARMOUTHIAN (2nd interglacial)		Soil, mature profile of weathering	
	600,000		
KANSAN (2nd glacial)		Drift, loess	Glaciers from northeast and northwest covered much of state
	700,000		
AFTONIAN (1st interglacial)		Soil, mature profile of weathering	
	900,000		
NEBRASKAN (1st glacial)		Drift	Glaciers from northwest invaded western Illinois
	1,200,000 or more		

(Illinois State Geological Survey, 1973)

SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS



(From Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)

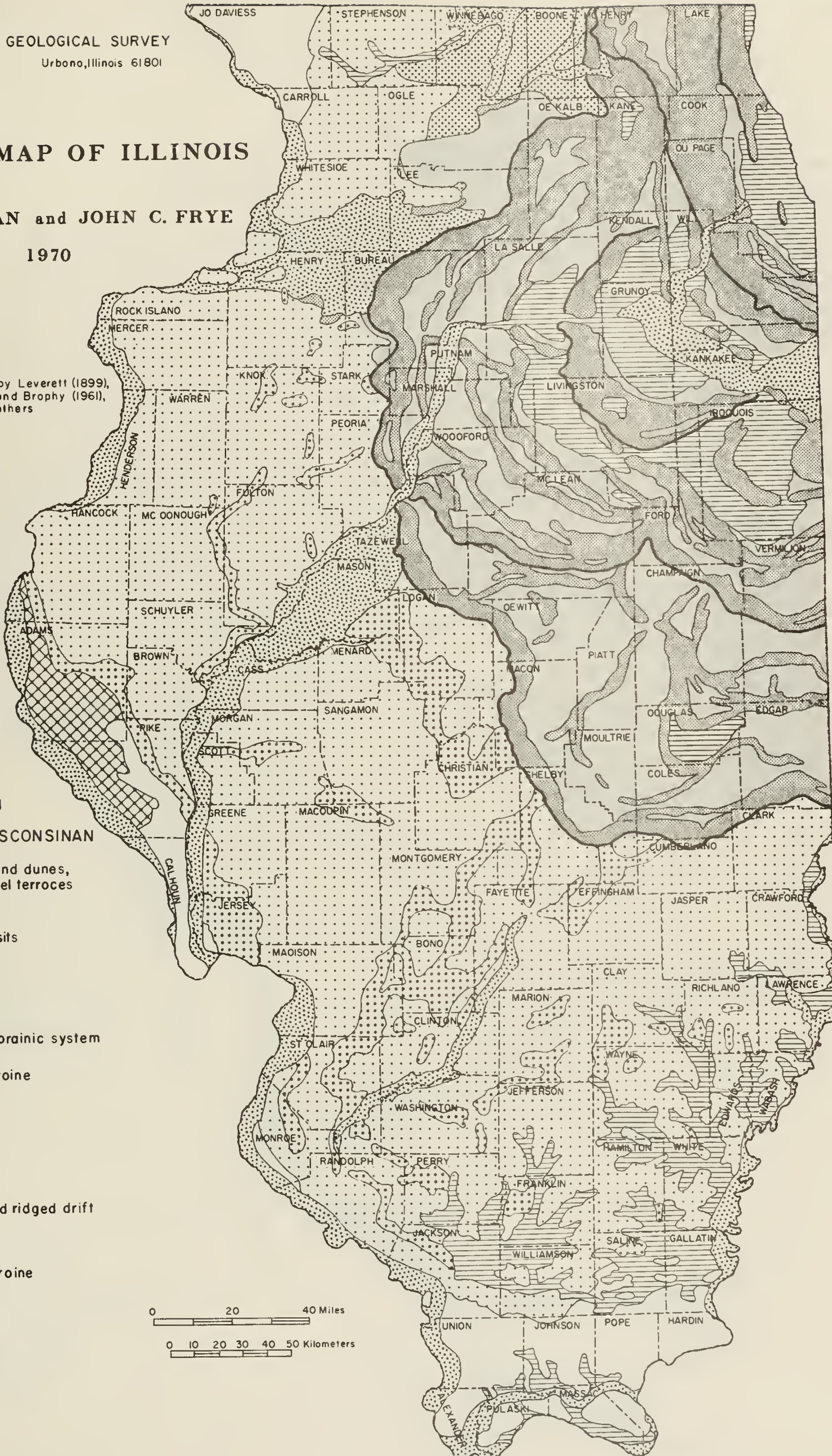
ILLINOIS STATE GEOLOGICAL SURVEY
John C. Frye, Chief   Urbana, Illinois 61801

GLACIAL MAP OF ILLINOIS

H.B. WILLMAN and JOHN C. FRYE

1970

Modified from maps by Leverett (1899), Ekblaw (1959), Leighton and Brophy (1961), Willman et al. (1967), and others



EXPLANATION

HOLOCENE AND WISCONSINAN

Alluvium, sand dunes, and gravel terraces

WISCONSINAN

Lake deposits

WOODFORDIAN

Moraine

Front of morainic system

Groundmoraine

ALTONIAN

Till plain

ILLINOIAN

Moraine and ridged drift

Groundmoraine

KANSAN

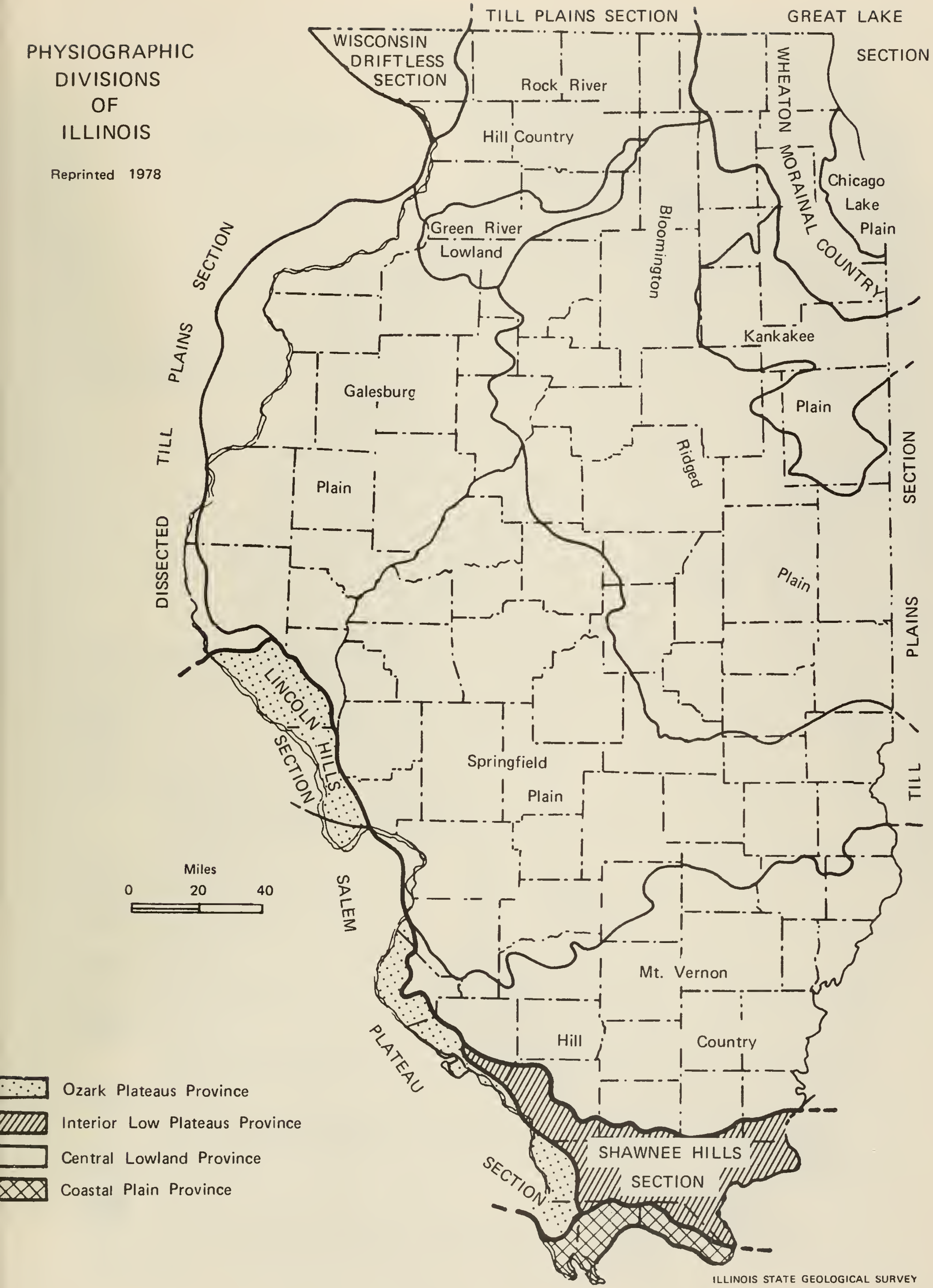
Till plain

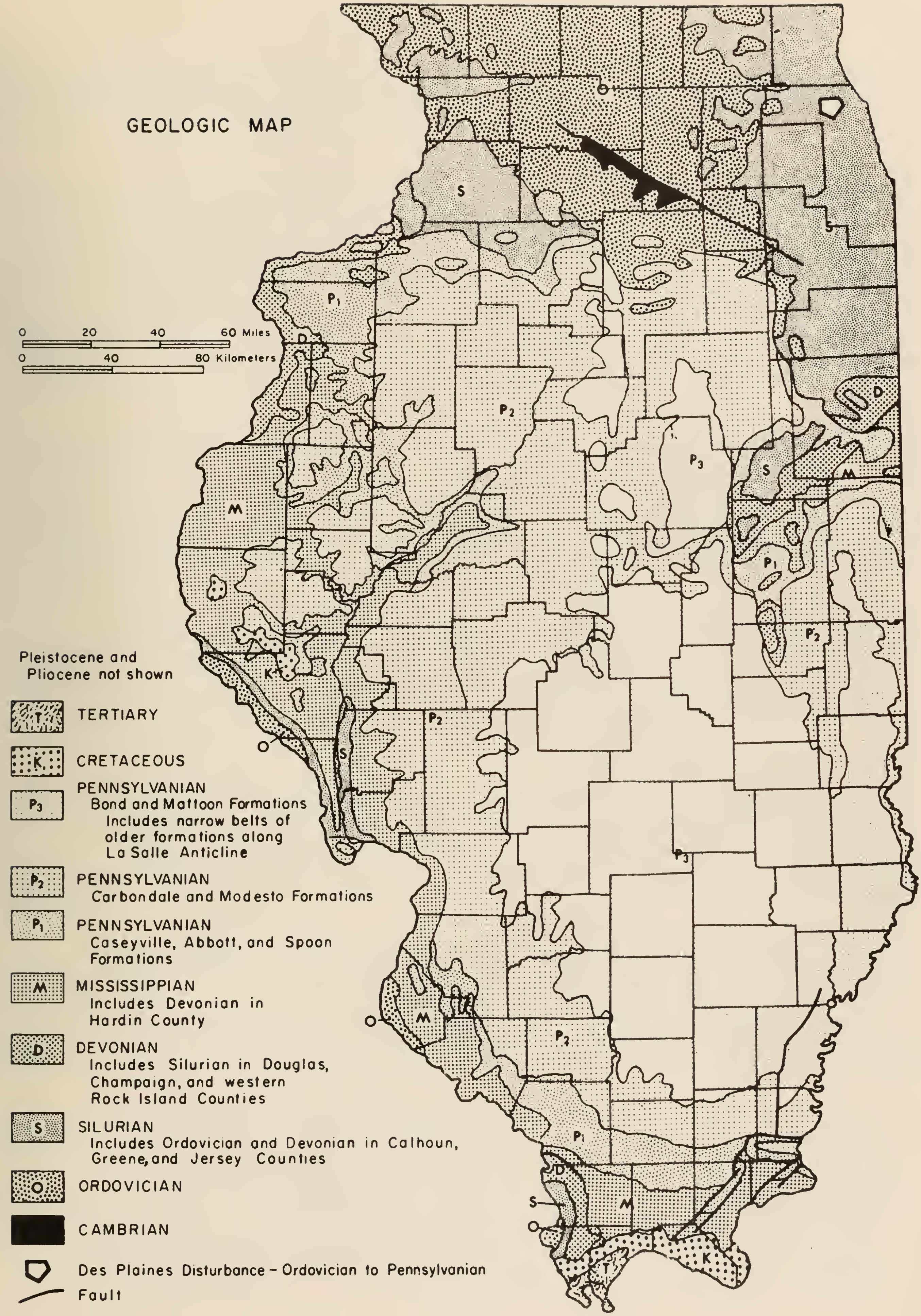
DRIFTLESS

Modified from Bull. 94.—pl.2

PHYSIOGRAPHIC
DIVISIONS
OF
ILLINOIS

Reprinted 1978




GEOLOGIC MAP
0 20 40 60 Miles
0 40 80 Kilometers
Pleistocene and
Pliocene not shown
T TERTIARY
K CRETACEOUS
P3 PENNSYLVANIAN
Bond and Mattoon Formations
Includes narrow belts of
older formations along
La Salle Anticline
P2 PENNSYLVANIAN
Carbondale and Modesto Formations
P1 PENNSYLVANIAN
Caseyville, Abbott, and Spoon
Formations
M MISSISSIPPIAN
Includes Devonian in
Hardin County
D DEVONIAN
Includes Silurian in Douglas,
Champaign, and western
Rock Island Counties
S SILURIAN
Includes Ordovician and Devonian in Calhoun,
Greene, and Jersey Counties
O ORDOVICIAN
CAMBRIAN
Des Plaines Disturbance – Ordovician to Pennsylvanian
Fault

MISSISSIPPIAN DEPOSITION

(The following quotation is from Report of Investigations 216: Classification of Genevievian and Chesterian...Rocks of Illinois (1965) by D. H. Swann, pp. 11-16. One figure and short sections of the text are omitted.)

During the Mississippian Period, the Illinois Basin was a slowly subsiding region with a vague north-south structural axis. It was flanked by structurally neutral regions to the east and west, corresponding to the present Cincinnati and Ozark Arches. These neighboring elements contributed insignificant amounts of sediment to the basin. Instead, the basin was filled by locally precipitated carbonate and by mud and sand eroded from highland areas far to the northeast in the eastern part of the Canadian Shield and perhaps the northeastward extension of the Appalachians. This sediment was brought to the Illinois region by a major river system, which it will be convenient to call the Michigan River (fig. 4) because it crossed the present state of Michigan from north to south or northeast to southwest....

The Michigan River delivered much sediment to the Illinois region during early Mississippian time. However, an advance of the sea midway in the Mississippian Period prevented sand and mud from reaching the area during deposition of the St. Louis Limestone. Genevievian time began with the lowering of sea level and the alternating deposition of shallow-water carbonate and clastic units in a pattern that persisted throughout the rest of the Mississippian. About a fourth of the fill of the basin during the late Mississippian was carbonate, another fourth was sand, and the remainder was mud carried down by the Michigan River.

Thickness, facies, and crossbedding...indicate the existence of a regional slope to the southwest, perpendicular to the prevailing north 65° west trend of the shorelines. The Illinois Basin, although developing structurally during this time, was not an embayment of the interior sea. Indeed, the mouth of the Michigan River generally extended out into the sea as a bird-foot delta, and the shoreline across the basin area may have been convex more often than concave.

....The shoreline was not static. Its position oscillated through a range of perhaps 600 to 1000 or more miles. At times it was so far south that land conditions existed throughout the present area of the Illinois Basin. At other times it was so far north that there is no suggestion of near-shore environment in the sediments still preserved. This migration of the shoreline and of the accompanying sedimentation belts determined the composition and position of Genevievian and Chesterian rock bodies.

Lateral shifts in the course of the Michigan River also influenced the placement of the rock bodies. At times the river brought its load of sediment to the eastern edge of the basin, at times to the center, and at times to the western edge. This lateral shifting occurred within a range of about 200 miles. The Cincinnati and Ozark areas did not themselves provide sediments, but, rather, the Michigan River tended to avoid those relatively positive areas in favor of the down-warped basin axis

Sedimentation belts during this time were not symmetrical with respect to the mouth of the Michigan River. They were distorted by the position of the river relative to the Ozark and Cincinnati shoal areas, but of greater importance was sea current or drift to the northwest. This carried off most of the mud contributed by the river, narrowing the shale belt east of the river mouth and broadening it west of the mouth. Facies and isopach maps of individual units show several times as much shale west of the locus of sand deposition as east of it. The facies maps of the entire Chesterian...show maximum sandstone deposition in a northeast-southwest

belt that bisects the basin. The total thickness of limestone is greatest along the southern border of the basin and is relatively constant along that entire border. The proportion of limestone, however, is much higher at the eastern end than along the rest of the southern border, because little mud was carried southeastward against the prevailing sea current. Instead, the mud was carried to the northwest and the highest proportion of shale is found in the northwestern part of the basin.

Genevievian and Chesterian seas generally extended from the Illinois Basin eastward across the Cincinnati Shoal area and the Appalachian Basin. Little terrigenous sediment reached the Cincinnati Shoal area from either the west or the east, and the section consists of thin limestone units representing all or most of the major cycles. The proportion of inorganically precipitated limestone is relatively high and the waters over the shoal area were commonly hypersaline... Erosion of the shoal area at times is indicated by the presence of conodonts eroded from the St. Louis Limestone and redeposited in the lower part of the Gasper Limestone at the southeast corner of the Illinois Basin...

The shoal area included regions somewhat east of the present Cincinnati axis and extended from Ohio, and probably southeastern Indiana, through central and east-central Kentucky and Tennessee into Alabama....

Toward the west, the seaway was commonly continuous between the Illinois Basin and central Iowa, although only the record of Genevievian and earliest Chesterian is still preserved. The seas generally extended from the Illinois and Black Warrior regions into the Arkansas Valley region, and the presence of Chesterian outliers high in the Ozarks indicates that at times the Ozark area was covered. Althougl the sea was continuous into the Ouachita region, detailed correlation of the Illinois sediments with the geosynclinal deposits of this area is difficult.

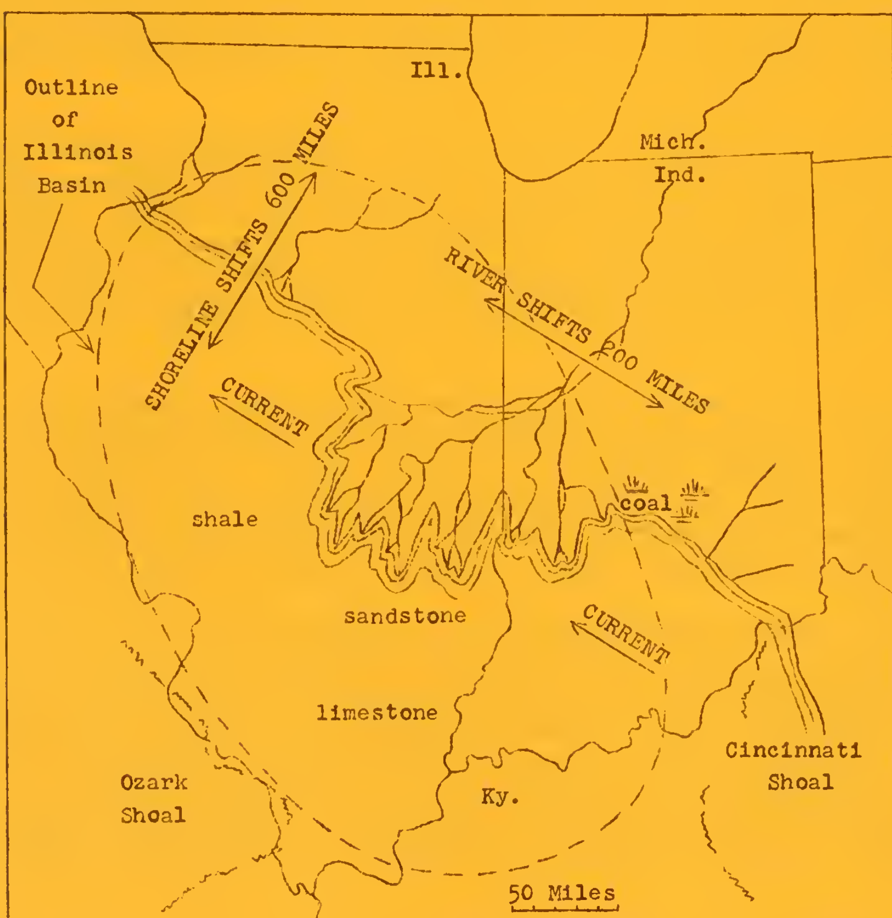
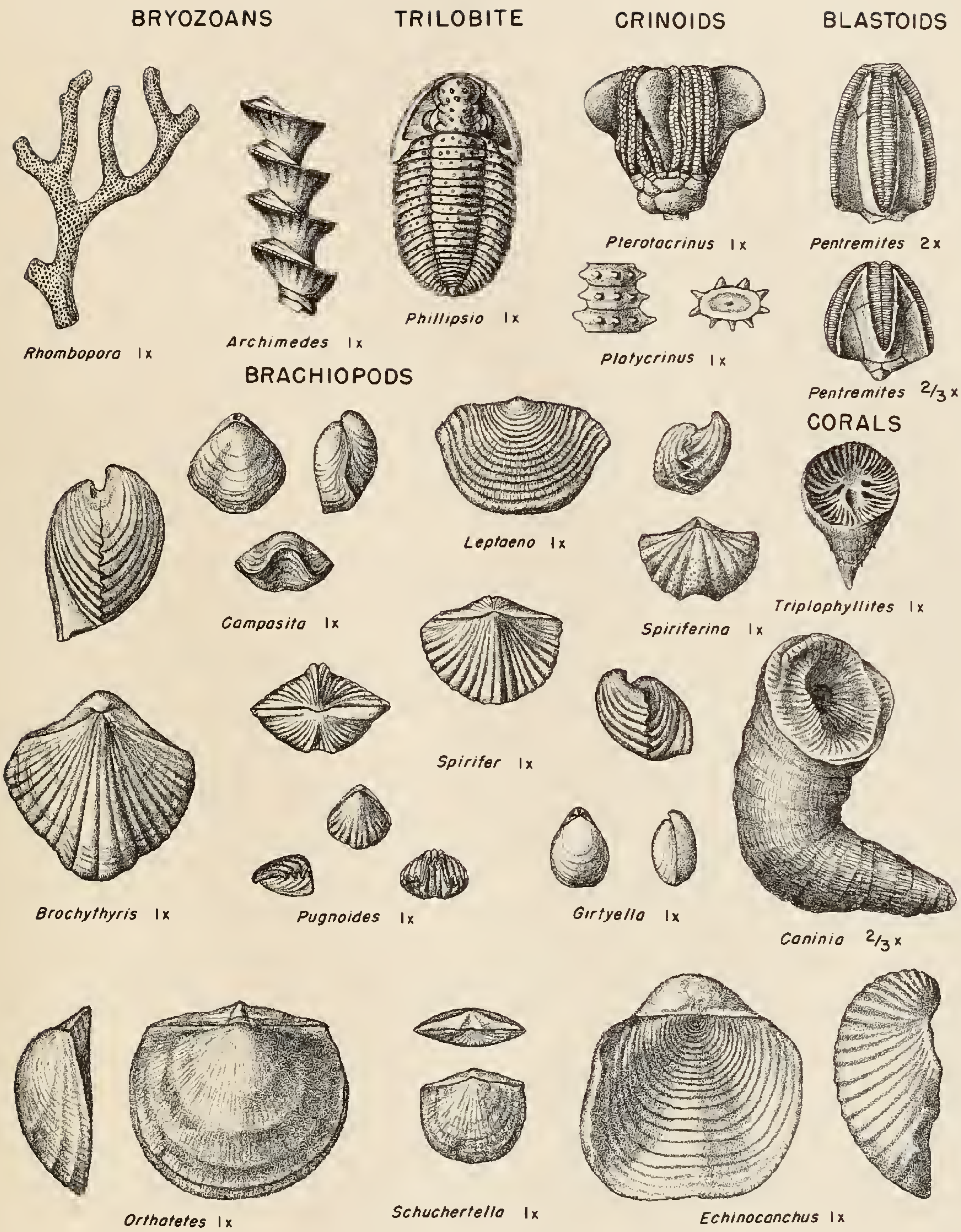


Fig. 4 - Paleogeography at an intermediate stage during Chesterian sedimentation.



BRYOZOANS
TRILOBITE
CRINOIDS
BLASTOIDS
Rhombopora 1x
Archimedes 1x
Phillipsia 1x
Pterotocrinus 1x
Platycrinus 1x
Pentremites 2x
Pentremites 2/3x
BRACHIOPODS
CORALS
Leptaena 1x
Composita 1x
Spiriferina 1x
Triplophyllites 1x
Spirifer 1x
Brachythyris 1x
Pugnoides 1x
Girtyella 1x
Caninia 2/3x
Orthotetes 1x
Schuchertella 1x
Echinoconchus 1x

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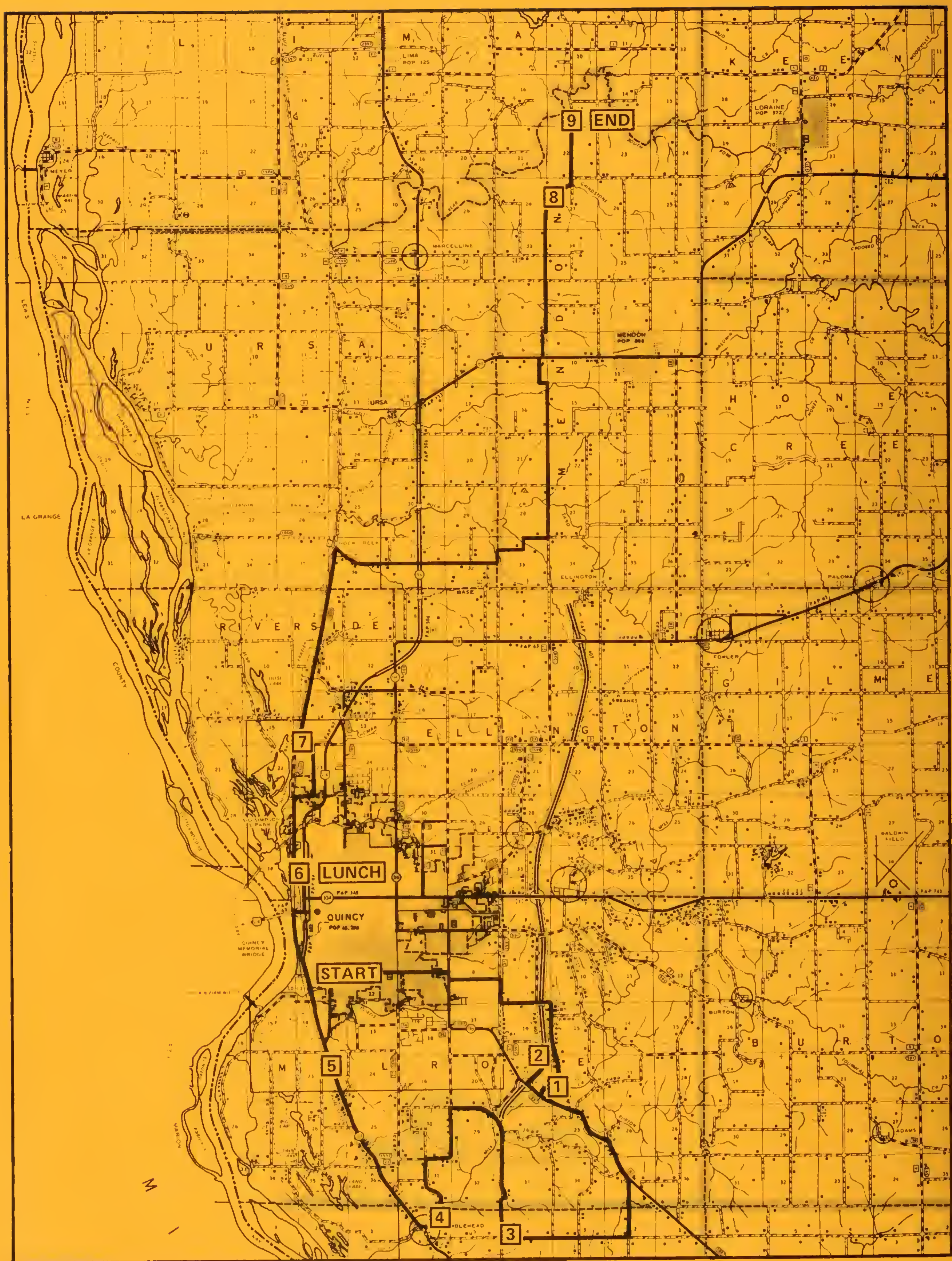
START
1
2
3
4
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6
LUNCH
7
8
9
END
QUINCY
MARCELLINE
URSA
ELLINGTON
MENDON
LORAINE
FOWLER
PALOMA
BURTON
LA GRANGE
QUINCY MEMORIAL BRIDGE
R I V E R S I D E
E L L I N G T O N
G I L M E R
U R S A
M E N D O N
K E E N E
H O N E Y C R E E K
M E L R O S E
B U R T O N
L I M A